

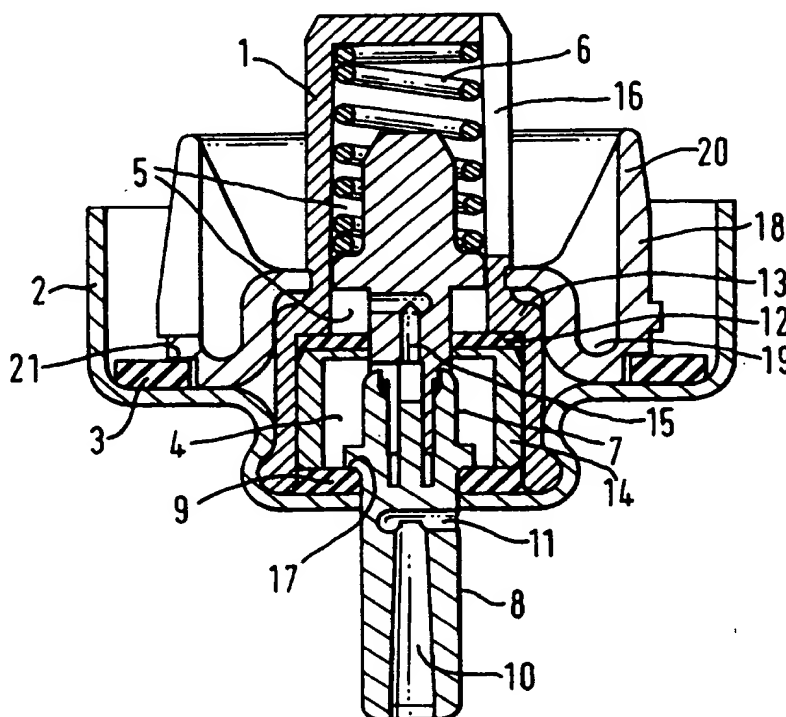
## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification <sup>6</sup> : <b>B65D 83/14</b>		A1	(11) International Publication Number: <b>WO 99/06303</b>
			(43) International Publication Date: 11 February 1999 (11.02.99)
(21) International Application Number: PCT/EP98/04681 (22) International Filing Date: 27 July 1998 (27.07.98) (30) Priority Data: 9715855.4 29 July 1997 (29.07.97) GB (71) Applicant (for all designated States except US): GLAXO GROUP LIMITED [GB/GB]; Glaxo Wellcome House, Berkeley Avenue, Greenford, Middlesex UB6 0NN (GB). (72) Inventor; and (75) Inventor/Applicant (for US only): RIEBE, Michael, Thomas [US/US]; Glaxo Wellcome Inc., Five Moore Drive, Research Triangle Park, NC 27709 (US). (74) Agent: PIKE, Christopher, G.; Glaxo Wellcome plc, Glaxo Wellcome House, Berkeley Avenue, Greenford, Middlesex UB6 0NN (GB).		(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, HR, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).  <b>Published</b> <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>	

(54) Title: VALVE FOR AEROSOL CONTAINER

## (57) Abstract

There is provided a valve for an aerosol container for dispensing a suspension or solution of a substance in a liquid propellant contained therein. The valve comprises a valve body (1) defining an aperture, a seal (9) mounted at the aperture, and a valve stem (7) having a dispensing passage (15), the valve stem (7) being slideably moveable through the seal (9) such that in a first position the valve is closed to prevent the substance to be dispensed from entering the dispensing passage (15), and in a second position the valve is opened to allow the substance to be dispensed through the dispensing passage (15). The seal (9) is made from a material comprising a fluorine-containing polymer.



**FOR THE PURPOSES OF INFORMATION ONLY**

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

## VALVE FOR AEROSOL CONTAINER

This invention relates to a valve for an aerosol container with the aid of which a quantity of the contents thereof can be dispensed. The invention has particular application to the dispensing of metered doses of medicaments, though it is applicable to the dispensing of aerosols generally.

The continuing use of aerosol formulations comprising conventional chlorofluorocarbon propellants is being debated due to the suspected role of such propellants in atmospheric depletion of ozone. Accordingly, formulations based on alternative propellants such as HFA-134a (1,1,1,2-tetrafluoroethane) and HFA-227 (1,1,1,2,3,3,3-heptafluoropropane) are being developed to replace those conventional propellants thought to contribute to atmospheric ozone depletion.

Containers for aerosol formulations commonly comprise a vial body coupled to a valve. The valve comprises a valve stem through which the formulations is dispensed. Generally the valve includes a rubber valve seal intended to allow reciprocal movement of the valve stem while preventing leakage of propellant from the container.

It has been found that some conventional devices for delivering aerosols suffer impaired performance when used in connection with HFA-134a or HFA-227. Selection of suitable materials for use in valves to contain aerosol formulations based on these alternative propellants is complicated by interactions between the valve component materials and the formulation components, including the propellant. In conventional devices, particularly with some drug formulations the valve stem tends to stick, pause, or drag during the actuation cycle with the result that the user perceives an unsmooth action as the valve stem is depressed and released. This may be partly caused by the drug to be dispensed from the container sedimenting or precipitating out of the drug-propellant suspension or solution formulation and depositing on the internal valve components, the presence of drug on the sliding interface between valve stem and seal creating increased friction during operation.

International Patent Application No. PCT/US94/06900 describes an aerosol valve wherein the rubber valve seal is made of a composition specially selected to minimise leakage of the propellant through the interface between the valve seal and valve stem upon firing. Smoothness of operation is also improved with some formulations compared to devices involving conventional thermoset rubber seals. However, although such seal compositions may improve valve performance, they do not prevent build up of deposit on the valve components, and the problem of unsmooth action may persist.

It is an object to provide a valve with improved smoothness of operation which alleviates the problem of valve sticking.

According to one aspect of the present invention there is provided a valve for an aerosol container for dispensing a suspension of a substance in a liquid propellant contained therein, the valve comprising a valve body defining an aperture, a seal mounted at the aperture, and a valve stem having a dispensing passage, the valve stem being moveable through the seal such that in a first position the valve is closed to prevent the substance to be dispensed from entering the dispensing passage, and in a second position the valve is open to allow the substance to be dispensed through the dispensing passage, characterised in that the seal is made from a material comprising a fluorine-containing polymer.

According to another aspect of the present invention there is provided a valve seal comprising a fluorinated polymer.

According to a further aspect of the present invention there is provided an aerosol container comprising a valve as described herein.

Fluorine-containing polymers suitable for this purpose include polytetrafluoroethane (PTFE), ethylenetetrafluoroethylene (ETFE), perfluoroalkoxyalkane (PFA), fluorinated ethylene propylene (FEP), vinylidene fluoride (PVDF), and chlorinated ethylene tetrafluoroethylene.

PTFE has been found to be particularly advantageous as a lubricant due to its low coefficient of friction. Furthermore, PTFE significantly reduces the problem of drug deposition on the surface of the seal contacting the valve stem, so removing one of the causes of valve sticking. Micronised PTFE can be incorporated in a straight forward manner as part of the filler material for standard peroxide cured nitrile-based rubber seals in a normal mixing process. Alternatively, the surface of the seal component may be subjected to a fluorination process. PTFE is also non-toxic, an important consideration for aerosol devices for dispensing medicaments.

Suitably, the seal is made from a material which comprises up to 20 parts by weight of PTFE in 100 parts by weight of base polymer. Preferably, the seal comprises 5 to 10% by weight of PTFE.

Suitably, the valve is a metering valve comprising a metering chamber, a transfer passage through which a quantity of substance to be dispensed can pass from the container into the metering chamber, wherein in the first position the dispensing passage is isolated from the metering chamber by means of a first seal and the metering chamber is in communication with the container via the transfer passage, and in the second position the dispensing passage is in communication with the metering chamber and the transfer passage is isolated from the metering chamber by means of a second seal. The second seal may advantageously also be made of a material comprising a fluorine-containing polymer like the first seal.

Suitably the substance to be dispensed is a medicament suspended or dissolved in liquefied HFA134a or HFA-227.

Medicaments suitable for this purpose are, for example for the treatment of respiratory disorders such as asthma, bronchitis, chronic obstructive pulmonary diseases and chest infections. Additional medicaments may be selected from any other suitable drug useful in inhalation therapy and which may be presented as a suspension. Appropriate medicaments may thus be selected from, for example, analgesics, e.g. codeine, dihydromorphine, ergotamine, fentanyl or morphine; anginal preparations, e.g. diltiazem; antiallergics, e.g. cromoglycate,

ketotifen or neodocromil; antiinfectives e.g. cephalosporins, penicillins, streptomycin, sulphonamides, tetracyclines and pentamidine; antihistamines, e.g. methapyrilene anti-inflammatories, e.g. fluticasone propionate, beclomethasone dipropionate, flunisolide, budesonide or triamcinolone acetonide; antitussives, e.g. noscapine; bronchodilators, e.g. salmeterol, salbutamol, ephedrine, adrenaline, fenoterol, formoterol, isoprenaline, metaproterenol, phenylephrine, phenylpropanolamine, pirbuterol, reproterol, rimiterol, terbutaline, isoetharine, tulobuterol orciprenaline, or(-)-4-amino-3,5-dichloro- $\alpha$ -[[[6-[2-(2-pyridinyl)ethoxy]-hexyl]amino]methyl] benzenemethanol; diuretics, e.g. amiloride; anticholinergics e.g. ipratropium, atropine or oxitropium; hormones, e.g. cortisone, hydrocortisone or prednisolone; xanthines e.g. aminophylline, choline theophyllinate, lysine theophyllinate or theophylline and therapeutic proteins and peptides, e.g. insulin or glucagon. It will be clear to a person skilled in the art that, where appropriate, the medicaments may be used in the form of salts (e.g. as alkali metal or amine salts or as acid addition salts) or as esters (e.g. lower alkyl esters) or as solvates (e.g. hydrates) to optimise the activity and/or stability of the medicament. Preferred medicaments are salbutamol, salbutamol sulphate, salmeterol, salmeterol xinafoate, fluticasone propionate, beclomethasone dipropionate and terbutaline sulphate. It is to be understood that the suspension or solution of medicament may consist purely of one or more active ingredients.

Preferably the medicament is salmeterol xinafoate, salbutamol sulphate, fluticasone propionate or a combination thereof.

The invention will now be described further with reference to the accompanying drawing in which Figure 1 is a section through a metering valve according to the invention.

A valve according to the invention is shown in Figure 1 and comprises a valve body 1 sealed in a ferrule 2 by means of crimping, the ferrule itself being set on the neck of a container (not shown) with interposition of a gasket 3 in a well-known manner. The container is filled with a suspension of salmeterol xinafoate in liquid propellant HFA134a.

The valve body 1 is formed at its lower part with a metering chamber 4, and its upper part with a sampling chamber 5 which also acts as a housing for a return spring 6. The words "upper" and "lower" are used for the container when it is in a use orientation with the neck of the container and valve at the lower end of the container which corresponds to the orientation of the valve as shown in Figure 1. Inside the valve body 1 is disposed a valve stem 7, a part 8 of which extends outside the valve through a first lower stem seal 9 and ferrule 2. The stem part 8 is formed with an inner axial or longitudinal canal 10 opening at the outer end of the stem and in communication with a radial passage 11.

The upper portion of stem 7 has a diameter such that it can pass slidably through an opening in a second upper stem seal 12 and will engage the periphery of that opening sufficiently to provide a seal. Both seals 9 and 12 are made from a peroxide cured nitrile rubber comprising 15 parts of PTFE in 100 parts of base polymer, the former component having the effect of reducing the friction between the seals and valve stem during actuation, as explained below. PTFE also has the effect of reducing any build up of drug deposition on the surface of the seal contacting the valve stem, the presence of which on the sliding interface between the valve stem and seal could otherwise cause increased friction during actuation. Upper stem seal 12 is held in position against a step 13 formed in the valve body 1 between the said lower and upper parts by a sleeve 14 which defines the metering chamber 4 between lower stem seal 9 and upper stem seal 12. The valve stem 7 has a passage 15 which, when the stem is in the inoperative position shown, provides a communication between the metering chamber 4 and sampling chamber 5, which itself communicates with the interior of the container via orifice 16 formed in the side of the valve body 1.

Valve stem 7 is biased downwardly to the inoperative position by return spring 6 and is provided with a shoulder 17 which abuts against lower stem seal 9. In the inoperative position as shown in Figure 1 shoulder 17 abuts against lower stem seal 9 and radial passage 11 opens below lower stem seal 9 so that the metering chamber 4 is isolated from canal 10 and suspension inside cannot escape.

A ring 18 having a "U" shaped cross section extending in a radial direction is disposed around the valve body below orifice 16 so as to form a trough 19 around the valve body. As seen in Figure 1 the ring is formed as a separate component having an inner annular contacting rim of a diameter suitable to provide a friction fit over the upper part of valve body 1, the ring seating against step 13 below the orifice 16. However, the ring 18 may alternatively be formed as an integrally moulded part of valve body 1.

To use the device the container is first shaken to homogenise the suspension within the container. The user then depresses the valve stem 7 against the force of the spring 6. When the valve stem is depressed both ends of the passage 15 come to lie on the side of upper stem seal 12 remote from the metering chamber 4. Thus a dose is metered within the metering chamber. Continued depression of the valve stem will move the radial passage 11 into the metering chamber 4 while the upper stem seal 12 seals against the valve stem body. Thus, the metered dose can exit through the radial passage 11 and the outlet canal 10.

Releasing the valve stem causes it to return to the illustrated position under the force of the spring 6. The passage 15 then once again provides communication between the metering chamber 4 and sampling chamber 5. Accordingly, at this stage liquid passes under pressure from the container through orifice 16, through the passage 15 and thence into the metering chamber 4 to fill it.

It has been found that the valve described above offers consistently smoother actuation throughout its life compared with valves using conventional nitrile-based rubber seals having no PTFE when used to dispense the same product. The following table presents a comparison of the mean friction energy generated in valves during actuation of two aerosol containers having standard nitrile-based rubber seals against two containers having PTFE impregnated seals at different stages during the life of the containers.



Valve	Friction Energy (mJ)		
	Start of can	After 100 actuations	After 200 actuations
Standard	40	50	52
With PTFE impregnated seals	38	40	40

5 The containers used to generate this data contained a suspension of salbutamol sulphate in liquefied HFA134a, and the results illustrate the consistently reduced level of friction present in valves according to the invention compared with valves having conventional seals.

10 It will be understood that the present disclosure is for the purpose of illustration only and the invention extends to modifications, variations and improvements thereto.

Claims

1. Valve for an aerosol container for dispensing a suspension or solution  
5 of a substance in a liquid propellant contained therein, the valve comprising a valve body defining an aperture, a seal mounted at the aperture, and a valve stem having a dispensing passage, the valve stem being slideably moveable through the seal such that in a first position the valve is closed to prevent the  
10 substance to be dispensed from entering the dispensing passage, and in a second position the valve is open to allow the substance to be dispensed through the dispensing passage, characterised in that the seal is made from a material comprising a fluorine-containing polymer.
2. Valve according to claim 1, wherein the seal is made from a material  
15 which comprises up to 20% by weight of PTFE.
3. Valve according to either of claims 1 or 2 wherein the valve stem  
comprises a lubricant.
- 20 4. Valve according to claim 3 wherein the lubricant is PTFE.
5. Valve according to any of claims 1 to 4, wherein the valve is a  
metering valve comprising a metering chamber, a transfer passage through  
25 which a quantity of substance to be dispensed can pass from the container into the metering chamber, wherein in the first position the dispensing passage is isolated from the metering chamber and the metering chamber is in  
communication with the container via the transfer passage, and in the second  
position the dispensing passage is in communication with the metering chamber  
and the transfer passage is isolated from the metering chamber.  
30
6. Valve according to claim 5, wherein, the substance to be dispensed is  
a medicament suspended in liquefied HFA134a.
7. Valve according to claim 6, wherein the medicament is salmeterol  
35 xinafoate, salbutamol sulphate, fluticasone propionate or a combination thereof.

8. Valve seal comprising a fluorine-containing polymer.
9. Aerosol container comprising a valve according to any of claims 1 to 7.

1 / 1

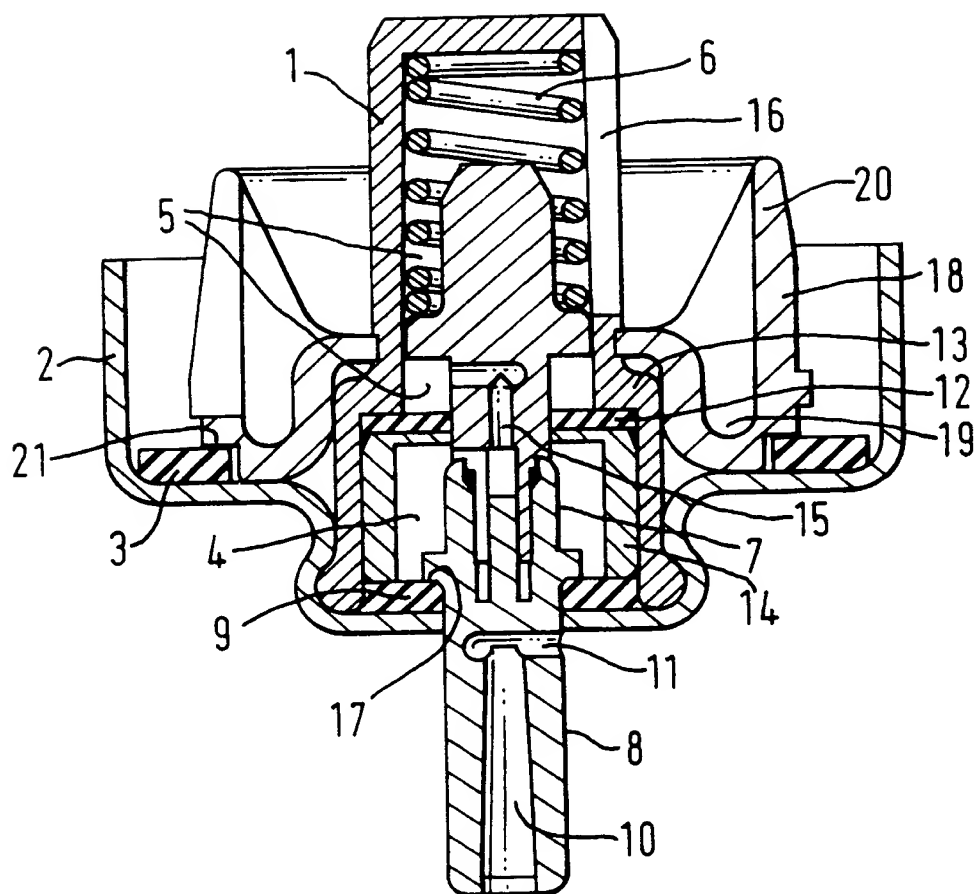


FIG. 1.

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 98/04681

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 6 B65D83/14

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 B65D C09K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 96 32344 A (GLAXO GROUP LTD ;HISCOCKS PETER GERARD (GB); GEE DAVID LAURENCE (G) 17 October 1996	1,5-9
Y	see page 4, line 33 - page 8, line 5 see page 9, line 1 - line 33 see figures 1A,1B	2-4
Y	FR 2 144 386 A (UNION CARBIDE CORP) 9 February 1973 see page 1, line 22 - page 3, line 9 see page 4, line 2 - line 9 see page 5, line 5 - line 17	2-4
X	US 5 027 986 A (HEINZEL IRVING C ET AL) 2 July 1991 see column 2, line 45 - column 3, line 12 see column 4, line 64 - column 5, line 23 see figures 1-4	1,8,9
	--- -/--	

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.**Special categories of cited documents:**

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&amp;" document member of the same patent family

Date of the actual completion of the international search

7 December 1998

Date of mailing of the international search report

14/12/1998

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

Papatheofrastou, M

# INTERNATIONAL SEARCH REPORT

Inventor's Name  
Application No  
PCT/EP 98/04681

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	FR 2 740 527 A (VALOIS) 30 April 1997 see page 2, line 28 - page 3, line 29 see figures 1,2 -----	1,3,4

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/EP 98/04681

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9632344 A	17-10-1996	AU 5500696 A	30-10-1996
		CA 2217949 A	17-10-1996
		CN 1186474 A	01-07-1998
		EP 0820415 A	28-01-1998
		HU 9801701 A	28-10-1998
		NO 974707 A	10-12-1997
		PL 322746 A	16-02-1998
FR 2144386 A	09-02-1973	NONE	
US 5027986 A	02-07-1991	NONE	
FR 2740527 A	30-04-1997	EP 0858420 A	19-08-1998
		WO 9716360 A	09-05-1997

**THIS PAGE BLANK (USPTO)**